Biotechnology: Revolutionary Approach to Improve Plant Productivity

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Abstract

Plants are primary producers and the life on earth totally depends on plants as there are Primary producers. Biotechnology is a modern tool to increase the productivity of plants by using various techniques. Tissue culture is a major breakthrough in biotechnology to increase the productivity of medicinally and economically important plants.

Key Words:-Bio molecules, Primary metabolites, Secondary metabolites, Tissue culture

Introduction

Human beings are surviving and interacting in the territory of nature. The biosphere, the thin shell of the earth and its land cover and the entire world that is alive are the biggest element in the environment that lies close to man. Not only is Nature supportive, it's definitely lovely. The creation of God is a work of art, iff this outer philosophy doesn't exist; the human being will vanish from reality. Nature is a beautiful, materialized, energetic, knowledge. Plants are the foundation of all life on Earth, providing foodstuffs, essential oils, gum, antibiotics, alkaloids, hormones, glycosides, and other medicinal substances such as fuel, fiber, latex, pigments or resins and a variety of other raw materials. Coal and petroleum are plant-derived fossil substances. (Sotannde and Oluwadare, 2014; Sfiligoj *et al*., 2013; Kumar et al., 2021; Habib and Khan, 2021).

Plants are the essential biotic component of nature and also a vital part of the cosmos. Since the dawn of human civilization, people have used plants as medicines after many discoveries and trials, several medicinal plants were recognized as an important medicine source, and cures started from the beginning of human civilization (Talay and Talay, 2001). Ancient men lived in constant fear of illness at the hands of nature and used plants to heal and alleviate their physical suffering, he even altered the surroundings nature and atmosphere and transformed plants and animals. Man and nature interrelate in such a manner as to actively rely on nature as civilization grows, while its dependency implicitly grows. Nature gave us an abundance of herbal medicines to cure diseases mainly.

The therapeutic use of plants is most likely as old as Human kind itself. The past decade has witnessed a tremendous resurgence in the interest and use of medicinal plant products (Fitzgerald et al., 2020; Bhattacharya et al., 2021). The common system of herb extracts as treatment for medicine in India goes back to the early days of the 'Rig-Veda.' Medicinal plants are natural and have no side effects; they are healthy, cost-effective, and curative and have properties to achieve the 'health for all' goal. It is known that 20,000-30,000 higher plant species in various parts of the world are used as medicines. Among 1500 are used for codified Ayurvedic medicinal products, 3000 in ethnomedicine and 700 in modern medicines from these plant species (Eggleton, 2020).

India has been a leading global exporter of medicinal plants and herbs, with large exports from India. As indigenous drugs have gained importance, there is an unforeseen increase in a large number of pharmacies. The intake and demand for crude medicines have risen significantly. To fulfill the demand, every year, a large number of crude drugs are being exploited in an indiscriminate manner from all parts of the country. Besides this we also lose our natural herbal richness more quickly due to illegal cuttings and other biotic interferences. These reasons have attributed to the imbalance in demand and supply, which is increasing day by day.

Biotechnology and Plant Improvement

Biotechnology is a branch of applied biology dealing with the use of living organisms and bioprocesses in architecture, electronics, medicine, and other areas that include bio-products. It is a rapidly evolving 21st-century technology or interdisciplinary science that has already had an impact on both commercial and non-commercial areas of human life. It originated as a modern scientific discipline as a result of the convergence of biochemistry, molecular biology, and microbiology (Sonkaria and Khare, 2020; Alemu, 2020). Biotechnology has great promise and has already provided new breakthroughs in healthcare, medicine, oil, agricultural products, and environmental conservation. However, due to its relevance, it has lately gained a great deal of media interest. In reality, biotechnology is one of the world's most research-intensive industries (Sohn, 2020). Biological developments have had a massive impact in the developed world and are only starting to pay off handsomely in emerging countries. The biotech industry in India has developed at an exponential pace. Genetic engineering, cell fusion technology, bioprocess technologies, and structure-based molecular designs are some of the emerging biotechnologies behind the bio-industrial revolution. Food research, antibiotic and medicine development, the molecular biotechnology revolution, protein and DNA technology, plant tissue culture, pharmaceuticals, bioenergetics, and information technology are among its diverse and multidisciplinary practices (Kovalevskaya *et al*., 2008).

This generic technology is used to alter and enhance the performance of plants, animals, and microorganisms. The pharmaceutical industry has reaped the biggest gains from this technology. Biotechnology has made, and will continue to make, a significant contribution to human health by offering cutting-edge knowledge into disease and serving as a critical enabler in the drug-discovery process. Globally, there is a growing need for modern and advanced agricultural research that will contribute to improved agricultural productivity. Not just crops, but also the livestock industry,

fisheries, and forestry, have felt the effects of biotechnology's strong resources (Smithies, 2020). Bioengineering is another significant field that underpins biotechnological applications. Traditional biotechnology companies are expanding their horizons as existing methods and emerging approaches advance, allowing them to improve the quality of their products and increase the performance of their processes.

Plant biotechnology, in its broadest sense, is thus prevalent in all societies and, for some applications, highly evolved, having advanced through a considerable range of technological and intellectual advances. Biotechnology has arisen as an important method for the mass reproduction and improvement of all plant organisms. Clonal multiplication is the rapid growth of true plants from a limited number of plants within a short period of time. It provides a mechanism for rapidly growing essential genotypes and hastening the release of a significant number of plantlets. (Tyagi *et al*., 2003).

The bioactive molecules are plant-derived natural compounds. Secondary metabolites are bioactive molecules with a wide range of industrial applications, including pharmaceutical medicine and drug discovery. They are currently in high demand for research and their significant contribution to the long-term treatment of multiple chronic illnesses with no side effects. The main focus of present day study is on discovering new bioactive compounds for the development of experimental medicines to treat diseases such as cancer, viral fever, diabetes, and AIDS, among others (Pan et al., 2013).

In recent decades, biomolecules have attracted the attention of scientists from various fields, including botanists, biochemists, biotechnologists, chemists, and pharmacologists, resulting in the establishment of comprehensive databases of natural products as well as knowledge of bio-molecule structures (Sorokina and Steinbeck, 2020).

Biomolecules are now engineered and planned to be bundled in nanomaterials (Care et al., 2015; Sampath et al., 2020). They are used in nanomaterial synthesis, biomolecule immobilisation, surgical implants, stabilisation, sensors, and catalysis (Nagamune, 2017). Computer-aided methods have mainly been used to analyse structure, physicochemical properties, and dynamics as molecular biology and bioinformatics have progressed (Liwo, 2014).

Primary biomolecules are nucleic acids, amino acids, vitamins, and organic acids that are basic building blocks, used in fundamental processes in living organisms such as photosynthesis, respiration, protein and lipid metabolism (Maeda, 2019). Secondary metabolites contain phenols, alkaloids, hormones, contaminants, gibberellins, narcotics, medicines, and polymeric compounds (Wink 2010). They are produced as intermediates or end products during primary metabolism (Pott et al., 2019). They do not participate in any critical cell growth or development processes, but they are important as signalling molecules in defence (Isah, 2019). Many plants have secondary metabolites that have medicinal value (Eldahshan *et al*., 2013; Delshad *et al*., 2018).

Plants are also the primary drivers of pharmacological preparations of drugs all around the world (Hussein and El-Anssary, 2018). Scientists produced a variety of useful drugs from secondary biomolecules. Plants were used exclusively in ancient medicine. Following that, the concept of Ayurveda emerged. Most pathological drugs are dependent on herbs, such as quinine, ephedra,

piperine, and curcuma longa, which have been used as medicine since ancient times (Veeresham, 2012).

The pharmaceutical industry is highly reliant on wild plant species for raw materials and the manufacture of medicinally useful compounds. Indeed, public and market demand for many medicinal plants has been so strong that they risk extinction, resulting in a loss of genetic diversity. The natural environment for many herbs and trees is degrading due to rising global population, growing anthropogenic behaviour, increasingly eroding natural environments, a lack of sufficient agricultural methods, degradation of plant habitats, and the illicit and indiscriminate collection of plants from these habitats, among other causes. They are now on the edge of extinction. (Yang *et al*., 2008; Srithi *et al*., 2009).

However, advanced biotechnological methods of culturing plant cells and tissues can have innovative methods for rapidly and efficiently propagating essential, rare, and endangered medicinal plants. These methods are critical for selecting, multiplying, and preserving the critical genotypes of medicinal plants.

Plant tissue culture and Productivity

Plant tissue culture is a general concept that includes plant protoplast, cell, tissue, and organ culture. Plant tissue culture may play an important role in the "Ever Green Revolution," in which biotechnology and gene editing are used to improve crop yield and quality.

Tissue culture techniques are widely used to improve agriculture and forestry productivity by improving field crops, woodland, horticulture, and plantation crops. This process has been commercialized worldwide and has greatly led to the increased development of high quality planting seed, doubling, conserving, and transforming, in that order. (Debnath *et al*., 2006; Sujatha *et al*., 2008).

Secondary metabolites are found in very small amounts in plants; however, their synthesis can be significantly increased by plant tissue culture techniques, as this procedure is the best way for industrial production of many useful plant items (Chowdhury *et al*., 2007). Biotechnology is the most effective method for increasing the development of usable biochemical compounds in vitro (Pagare *et al*., 2015; Pyne *et al*., 2019). *In vitro* studies of plants experiments are currently insufficient to postulate any effect on secondary metabolite synthesis in leaf-derived calluses. Furthermore, this plant's phytochemistry has only been studied in plant sections. (Altamirano *et al*., 2019).

The majority of plant breeding programmes rely heavily on clonal propagation of selected phenotypes. In contrast to seed propagation, it is a smoother method of asexual reproduction. Plants produced by seed are strongly heterozygous, and the best plants must be chosen from a large population. Because of heterozygozygosity, seed raised plants show high variation in growth, habit, and yield, and they may be redundant due to the poor quality of their flowers and fruits for commercial release.

Similarly, the majority of plants propagated vegetatively contain microbes, fungi, and viruses that

alter the yield, consistency, and appearance of selected plants. The majority of the plants are not amenable to vegetative propagation through cuttings, budding, or grafting, restricting the multiplication of preferred cultivars. Tissue culture has emerged as a promising approach for producing genetically pure elite populations in vitro in recent years. (Nath *et al*., 2007; Arican *et al*., 2008; Babbar *et al*., 2009).

Realizing and examining the enormous importance of plants, the usefulness of biotechnology and its various uses in Biology, Microbiology, Molecular, Genetics, Nanotechnology, Bioinformatics, Biomolecules, Biochemistry, and Pharmaceuticals **is** rapidly increasing in modern times.

Conclusion

Biotechnology is the use of living organisms for production at industrial level Biotechnology is being used for agricultural crop production, to make the plants disease free, to increase the production of economically valuable, to enhance the amount of required biomolecules as well as secondary metabolites from medicinally important plants by using many new novel techniques like tissue culture, hairy root culture, genetic engineering.

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